NERL Research Abstract

EPA's National Exposure Research Laboratory
GPRA Goal 1 - Clean Air
APM # 511

Significant Research Findings

Particulate Matter Longitudinal Panel Studies

Scientific Problem and Policy Issues

The NERL Particulate Matter Longitudinal Panel Studies will be used to characterize temporal variation of personal exposure to particulate matter (PM) and related co-pollutants, including that of PM measured at ambient sites. These studies are fundamental to understanding the associations between personal exposure to PM, PM measured at ambient sites, and health effects, especially for susceptible subpopulations. Projects have been designed to evaluate different sub-populations, regions of the country, seasons, and housing conditions. Susceptible sub-populations include chronic obstructive-pulmonary disease (COPD) patients, individuals with cardiovascular disease, the elderly, and asthmatics. Data will be used to develop databases representing actual human exposures and will fill a critical scientific need for the Agency in identification of potentially important exposure variables, as well as providing inputs for modeling and risk assessment.

Research Approach

Beginning in 1997, a series of individual human exposure monitoring studies were conducted in Baltimore, MD, Fresno, CA, Seattle, WA, Atlanta, GA, Boston, MA, and Los Angeles, CA. These studies included healthy elderly individuals and elderly subjects with underlying cardiovascular disease, COPD, and a history of myocardial infarction. For each study, personal exposure measurements of $PM_{2.5}$ and PM_{10} were made. Measurements were also be taken at ambient, outdoor residential, and indoor residential locations. Copollutants such as carbon monoxide (CO), ozone, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), metals, and carbon were also measured. For each participant, information on time/activity patterns and potential sources of PM exposure was collected through questionnaires. Participants were monitored for 10 to 28 days to investigate both longitudinal and cross-sectional correlations between personal, indoor, outdoor, and ambient measurements. Specific human health effects information, such as heart rate variability, lung function, and blood pressure were monitored in some instances.

Results and Implications

The PM Longitudinal Panel Studies have developed techniques for the recruiting and retention of human subjects for studies involving personal exposure monitoring. In some instances, this involved as many as 15 subjects being monitored per day. The studies have determined that individual personal PM exposures may vary by season, residential and geographical setting, and subject grouping. In the absence of indoor-generated PM, exposure to ambient $PM_{2.5}$ (from being outdoors or infiltration of ambient PM indoors) appears to greatly affect personal exposures. This is evident in moderate-to-excellent correlations between personal or residential measurements with those obtained from ambient monitoring (often exceeding $r = 0.5$). $PM_{2.5}$ measured at various locations across the cities involved in the studies appear to be fairly homogeneous (often $r > 0.90$) with respect to mass concentration, with greater variations observed for the PM_{10} and PM_{coarse} size fractions. Real-time personal monitoring has provided information on determining potential sources of personal exposures as they relate to human activity patterns. Use of a consistent survey instrument across the majority of the studies and data from high-integrity measurements will prove invaluable to the research community. Extensive duration/activity/location data have been collected that will allow exposure modelers to have actual human exposure data for development of working models, rather than scripted or assumed exposure scenarios.

Research Collaboration and Publications

The PM Longitudinal Panel Studies were designed and conducted collaboratively by research teams at EPA's National Exposure Research Laboratory, EPA's National Health and Environmental Effects Research Laboratory, The University of Washington, Harvard University, New York University, and Research Triangle Institute. Recent publications from this study include:

Williams, R., Creason, J., Zweidinger, R., Watts, R., Sheldon, L., Shy, C. Indoor, outdoor, and personal exposure monitoring of particulate air pollution: The Baltimore elderly epidemiology-exposure pilot study. *Atmospheric Environment* 34: 4193-4204, 2000.

Reed, C.H., Rea, A., Zufall, M., Burke, J., Williams, R., Suggs, J., Sheldon, L., Walsh, D., Kwok, R. Use of a continuous nephelometer to measure personal exposure to particles during the U.S. EPA Baltimore and Fresno Panel Studies. *Journal of the Air & Waste Management Association* 50: 1125-1132, 2000.

Williams, R., Suggs, J., Zweidinger, R., Evans, G., Creason, J., Kwok, R., Rodes, C., Lawless, P., Sheldon, L. The 1998 Baltimore particulate matter epidemiology-exposure study: Part 1 - comparison of ambient, residential outdoor, indoor and apartment particulate matter monitoring. *Journal of Exposure Analysis and Environmental Epidemiology*. In press.

Williams, R., Suggs, J., Creason, J., Rodes, C., Lawless, P., Kwok, R., Zweidinger, R., Sheldon, L. The 1998 Baltimore particulate matter epidemiology-exposure study: Part 2 - Personal Exposure Assessment associated with an elderly study population. *Journal of Exposure Analysis and Environmental Epidemiology*. In press.

Williams, R., Suggs, J., Zweidinger, R., Evans, G., Creason, J., Kwok, R., Rodes C., Lawless, P., Sheldon, L. Comparison of $PM_{2.5}$ and PM_{10} monitors. *Journal of Exposure Analysis and Environmental Epidemiology* 10: 497-505, 2000.

Williams, R., Suggs, J., Sheldon, L., Saraiya, N., Evans, G., Creason, J., Rodes, C., Lawless, P. Comparison of gaseous criteria air pollutants and particulate matter concentrations involving an elderly subject population in a Baltimore panel study. *Journal of the Air & Waste Management Association*. Submitted.

Future Research

The Longitudinal Panel Studies began in 1997 and follow-up or new initiative cohorts are underway. These include repeat monitoring of subjects differing by season from initial surveys. Additional cohorts are currently being recruited (African-Americans living in poor neighborhoods and subjects with implanted cardiac defibrillators) as well as additional cities (Research Triangle Park, NC, New York, NY, and Irvine, CA). Several journal manuscripts detailing the completed studies have been prepared and will be published. Development of publicly available databases is being pursued that will allow EPA and others to access and utilize the data from the previous studies.

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